



Thank you for choosing icengineworks® FE Series systems for designing and fabricating precise full exhaust, and other large-OD projects such as downpipes, cold air intake tracks and turbo/intercooler tubing among others. Despite their simple appearance and manual operation, the icengineworks® FE Series modeling blocks pack an enormous amount of design power not seen before. When used as suggested, they will quickly yield precise full-scale, 3D exhaust models in real time, along with key design, budgeting and fabrication information for the user to duplicate in metal. With simple design features such as flexible 15-degree curved blocks with centerline radii in various specifications, and 5"-long straight blocks to cover distances more quickly, the icengineworks® FE Series modeling blocks are a versatile, easy-to-use, high precision design tool. Each block, molded in tough ABS plastic, is labeled with information such as its OD, its centerline radius (CLR) and witness line marks for reference when building complex tubular assemblies. For any given design, the user will be able to add, remove, replace and rotate the modeling blocks as many times as it takes until the design objectives are met. This innovative ability to quickly and manually revise, change and modify any design with precise and immediate feedback from the model constitutes the strength of this tool. It can be done over and over again until the entire design is completed to the user's satisfaction with minimum time invested, and no waste of expensive metal tubing, cutting or welding time.

With the plastic model completed, a metal version can be safely fabricated and its recipe recorded and preserved for future work. It is our mission that the use of this product will result in a noticeable and immediate increase in productivity, the quality of the emerging products and a drastic reduction in unnecessary waste of time and resources.

Before using, please read the following pages, which are meant as general guidelines and recommendations to get the most out of your investment. However, these are definitely not the final words. Experienced fabricators will be quick to adapt and incorporate their vast knowledge to this new design technology to reach higher levels of productivity and creativity.

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The actual design of the icengineworks® modeling blocks and the information and procedures described on the website and in this manual are subject to change without notice.

1. Contents

This box includes the following according to the part number, or as specified on the outside box label.

	2500FESeries (2-1/2"OD), BASIC/	3000FESERIES (3"OD), BASIC/
	PRO	PRO
1" Straight Block	24/36	24/36
5" Straight Block	12/24	12/24
3" – CLR Block	24/36	24/36
3.5" – CLR Block	24/36	-
4" – CLR Block	24/36	24/36
5" – CLR Block	24/36	24/36
6" – CLR Block	-	24/36
Instructions Manual	1	1
FESeries Control Sheet Pad	1	1
Plastic Storage Case	1	1
Rubber Block Adapters	4	4

2. Getting Ready

The icengineworks® modeling blocks snap firmly into each other to provide adequate friction and holding power among them when connected despite the weight of a given assembly. However, long, heavy sections should be supported as needed. Care must be observed when adding to or taking blocks away from an assembly to avoid upsetting other blocks. To take them apart, pull firmly away from each block as you gently spin them. Initial fitment will be tight when new. To preserve their useful life, it is recommended to avoid excessive rotation between them, which may wear out their tight fit prematurely. Plan ahead of time the key features in your intended design such as the OD and target pathway of the exhaust tubes, location of other components in the exhaust system like catalytic converters, resonators, mufflers, etc. Practice partial block sections prior to connecting them for added efficiency.

For a design to get started, it is required to have exhaust headers, manifolds or downpipes, whatever may be the case, in place and secure with their open end tubes clear of obstructions. This will allow a quick connection of the icengineworks® to the tube to begin the design process for the rest of the exhaust system.

The icengineworks® modeling blocks feature two molded arrows at their highest radial point to symbolize a 'zero' mark that 'clicks' blocks' witness lines into alignment. When arrows among the same block type (same CLR) are aligned, that section represents a single metal section because it is formed in the same geometrical plane of bend.

3. Getting a Design Started



To get started, an initial icengineworks® plastic modeling block of your choice needs to be anchored to the open end tube coming from the exhaust header collectors, downpipe, catalytic converter, etc.

The rubber block adapters have been designed to slide through friction into the open end tube while grabbing the initial modeling block to create a seamless and firm connection. For a quick, safe and painless connection, it is highly recommended that the open end tube is free of metal flash or sharp edges. It is also recommended to use gloves and apply some minor lube to the inside of the metal tube so the block adapter slides more easily. Install the block adapter into the icengineworks® modeling block by pressing, pushing and rotating the rubber bead on the short end of the block adapter into the female end of the icengineworks® modeling block.



Next, apply some light lube to the inside of the receiving open end tube which needs to be smooth edges and free of metal flash. This will ensure an easy entry of the block adapter into the metal tube without getting caught or damaged. Some flexing and pushing of the rubber will be required which is normal. Push in until flushed. To remove, simply pull out the block gently. The icengineworks® modeling blocks have arrows molded at each end. When aligned, these markers indicate when consecutive blocks of the same CLR can be sourced from the same J- or U-bend metal section during fabrication. When arrows don't line up, it means there is a change in geometrical planes at that location and a new section needs to be cut and welded with a different relative rotation, referred to as a weld joint.

With little practice, it will become evident how easy it is to design for the least amount of metal sections required when fabricating a given exhaust project. This practice minimizes the cutting and welding by grouping consecutive blocks of constant-CLR with straight blocks. By keeping track of the number of weld joints, the user will always be aware of how many sections need to be cut and welded, and where those welds will be located in the design. Complicated designs can always be revised to reach a simpler version to reproduce.

Also, avoid locating hard-to-reach weld joints such as behind the rear end. All this information is extremely valuable when estimating the entire cost of the project (metal, cutting and welding labor) before starting to cut metal.

As with any design process requires constant revisions and corrections until the desired goal is achieved. The icengineworks® modeling blocks are no exception to this rule, but the speed and simplicity at which this is achieved is one of its greatest strengths. As your design grows with new elements being added or replaced, some adjustments and corrections will become necessary in order to continue. As you sort out unexpected situations, new opportunities will arise. And so, the more time you spend analyzing and working the design, the more insight you will have to complete it to your satisfaction.

DESIGN TIP: Build icengineworks® modeling block assemblies of constant-CLR elements only between weld joints. Adding straight blocks before or after those constant-CLR sequences can sometimes reduce the number of required metal sections and therefore the amount of cutting and welding time needed. After you complete your exhaust design, carefully review each block section to make sure that there are no unwanted gaps or that the modeling blocks have not moved or rotated unexpectedly. Make sure witness line alignments among blocks in constant-CLR curved sections remain 'zero-ed' in. Next up, create a Control Sheet document for this project.

4. Transferring your Design to Metal



Fill out a U-Bend Metal Tubing Control Sheet for FESeries from the pad included following the printed directions. Each curved modeling block is 15-deg and it is represented in the U-bend drawings on the Control Sheets. Color as many empty blocks in the drawing as the number of blocks in each section in your design including the straight sections.

Label each drawing with the appropriate CLR used in the actual modeling block design. The completed form will become the recipe and budget for the parts and labor needed for your specific exhaust design: each section requires 2 cuts and the number of sections minus one is approximately the total number of welds required. It is also an exact shopping list for the metal bends needed.

5. Fabricating with the icengineworks® CUT System



The icengineworks® tube-cutting spacers and pivoting table (p/n PIV1002) simplify the fabrication of your design delivering consistent “square” cuts. This is critical for achieving precise butt-to-butt joints (circle-to-circle) which are easier to weld, plus they flow and look better. These tools require a vertical band saw with a rip fence or straight edge (Wilton 14” Band Saw Model 8201 shown here). Follow manufacturer’s instructions for properly setting the band saw before starting to cut metal including key blade sfm speeds, etc. Choose a side of the blade to provide the true cut and consider blade thickness when setting up the blade path. We recommend using a carpenter’s clamp to secure the metal Ubend tightly around the cutting spacer to avoid vibration. Following the Control Sheet filled out previously, use spare same-CLR icengineworks® blocks to recreate the sections listed in your design.



Place the plastic section around the matching-CLR icengineworks® cutting spacer and make sure there are no gaps between the spacer and the blocks model. Bringing the PIV plate forward towards the blade, rotate both until the curved end of the blocks touches the blade. Tighten the wing nut to secure the angle of cut. Replace the actual metal U-bend and make the cut. Use the plastic section again to lay it on top of the metal section you just cut and mark off where the straight section needs to be trimmed off. Use a horizontal band saw or chop saw. Label that section. Move on to the next section in the Control Sheet and repeat until all the metal sections are cut. The success of the icengineworks® modeling blocks depends on the ability to faithfully recreate metal versions of the plastic model.

6. Welding the Metal Sections



With all metal section cut per your Control Sheet, begin replacing them in your model. We recommend the use of the icengineworks® tack-welding clamps to recreate the entire assembly in metal and speed up the proper clocking and adjustment of the joints before tacking and final welding. The icengineworks® tack welding clamps require 2 basic adjustments. The first adjustment is the radial location of the setting ring and its pivoting hinge around the first tube, which creates the swinging motion to match the bend direction of the second tube in the joint. The second adjustment is done by locking the swinging ring along the second tube when it is ‘butted’ against the first. The resulting gapless joint should be located evenly between the setting and adjustable rings. Fine tune as necessary. Then proceed to place at least 3 tacks around each joint. Remove the tack-welding clamps and continue welding completely all the joints as usual.